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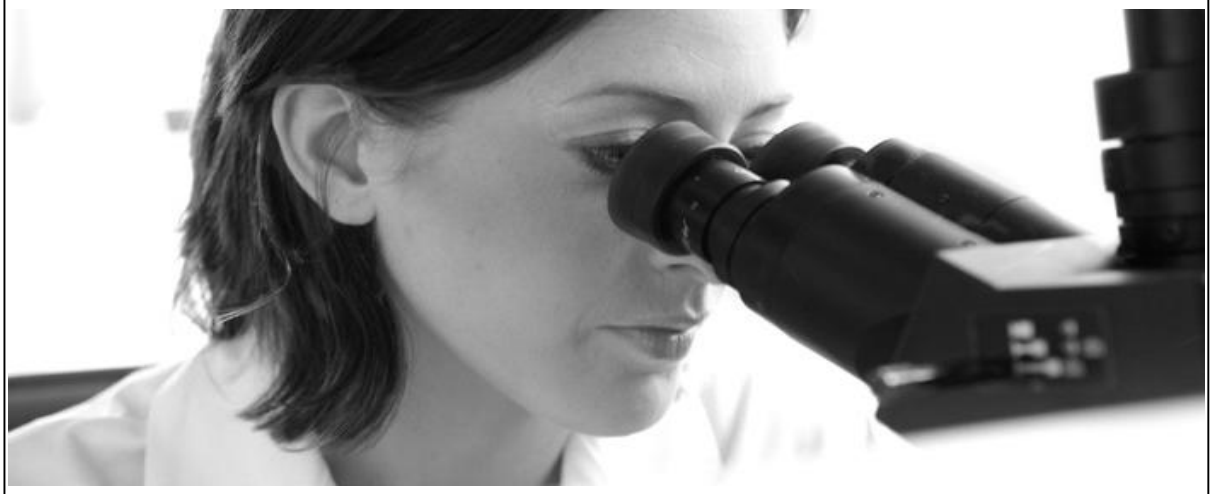

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RESEARCH ARTICLE

FORAGING BEHAVIOUR OF INDIAN HONEY BEE (*APIS CERENA INDICA FAB.*) IN BEE PASTURAGING PLANTS AT ANNAMALAINAGAR ECO SYSTEM

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ABSTRACT

Heneybees and flowering plants have been considered as an example for co-evolution and mutualism. Heneybees need flowering plants for nectar and pollen as source of food and flowering plants need honeybees for pollination. A honey bee is one of the most fascinating and marvelous insect whose usefulness is known to the mankind since the prehistoric times. Honey harvesting dates back to 7000 B.C. The present investigation was carried out during March, 2009 – 2013 at the Department of Entomology, Faculty of Agriculture, Annamalai University, Annamalainagar, Tamilnadu. The bee hives along with colonies were brought from Marthandam and YMCA (Young Men Christian Association). Installing bee colonies were done during January and February months. Colonies were installed near mango tree. By using coconut shells / plastic containers were filled with honey solution or honey syrup. These were used to feed the honey bee. Honeybees gathered nectar and pollen from plants as their food. The bees, however did not visit all the plants since they have their own floral preference depending upon the availability of different amounts of nectar and pollen. The flora of an area in characteristics of its agro-climatic conditions varies from place to place. During morning time, the foraging activities of bees were highly active when compared to noon.

INTRODUCTION

Pollination by insects is called entomophily. Entomophily is a form of pollination whereby pollen is distributed by insects, particularly bees, Lepidoptera (eg. Butterflies and moths), flies and beetles. Without pollination, no seed formation, no fruit formation and no food in market. A honey bee is no ordinary insect, but rather an extra ordinary insect and amazing creatures. A honey bee is one of the most fascinating and marvelous insect whose usefulness is known to the mankind since the prehistoric times. Honey harvesting dates back to 7000 B.C. and is perhaps the only industry which besides the production of sweet honey, bee wase and bee venom also helps in increased crop production through pollination of crops. Continuation and propagation of many plants growing in nature thereby maintaining the stability of ecosystem, environmental quality and bio diversity. These tiny winged creatures find mention in almost all the epics of the world. A honey bee colony has fascination of it own, the poets, the naturalists and thinkers have always admired then for their industriousness, self sacrifice, unity, calmness of spirit, equitable division of labour in their colonies and sprit of social service. (Abrol, 2010).

Heneybees and flowering plants have been considered as an example for co-evolution and mutualism. Heneybees need flowering plants for nectar and pollen as source of food and flowering plants need honeybees for pollination. (Kalpana and Ramanujam, 1997). Beekeeping is entirely depending on the types of flowering plants available in any given area. There is a need to understand honeybee plant relationship to study food preferences of honeybees and pollination requirement. Pollen of various plants representing potential source of nectar and pollen for the honeybees is an important pre-requisite for the developing apiary (Shubarani *et al*., 2013). Honey bees are a key component of global food security of the 100 crops that provide 90 per cent of the worlds food, 71 are bee pollinated and honey bees (*Apis mellifera L*.) are the managed pollinator conscripted to provide the necessary pollination services for most of these crops (Unites Nations Food and Agricultural Organization, 2005)

MATERIALS AND METHODS

In the present investigation, the pollen and nectar yielding plant species has been identified and studied during March, 2009 – 2013 at the Department of Entomology, Faculty of Agriculture, Annamalai University, Annamalainagar, Tamilnadu.

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Annamalainagar belongs to $11^0$24'N latitude of equator and $79^0$41'E longtitude and altitude + 5.79 m. The bee hives along with colonies were brought from Marthandam and YMCA (Young Men Christian Association). Installing bee colonies were done during January and February months. Colonies were installed near mango tree.

The sample of ripe pollen grains were collected from mature flower buds directly from the field after the plant has been confirmed as bee plant by visual observation that bees are foraging on plant either for nectar or for pollen or both. The mature pollen grains of the identified bee plant species are collected an preserved in 70 per cent alcohol for further investigation.

Preparation of floral calendar

Bee flora (Bee botany) of Indian honeybee was studied during the period 2009-13. The different pollinating plants were observed by bees. The list of bee pasturaging plants includes field crops, vegetable crops, weeds, ornamental and road side avenue trees.

Observations on bee foraging plants

Observations were made during different day hours. These were being visited by honey bees for collection of nectar or pollen or both. Such information is gathered for whole year. The floral calendars thus prepared will indicate honey flow and dearth period of the flora and the management of the colonies can be done accordingly.

Keeping sugar solution

By using coconut shells / plastic containers were filled with Sugar solution or Sugar syrup. These were used to feed the honey bee.

In general, sugar solution @ 1:1 ratio were used. Small broomsticks were kept inside the coconut shell through which honey bee climbing ups and downs. Small petriplates were maintained to keep the sugar solution.

Pollen collection

Honeybees gather nectar and pollen from plants as their food. The bees, however do not visit all the plants since they have their own floral preference depending upon the availability of different amounts of nectar and pollen. The plants from which bees collect nectar and pollen are known as bee flora or bee plants or bee forage or bee pasturage. The flora of an area in characteristics of its agro-climatic conditions and such as varies from place to place.

RESULTS AND DISCUSSION

Bee foraging list Data collected during the study is presented in table1. The information incorporates different species useful as source of forage to honeybees. The pollen morphology varies among different plant species occur in varying shapes and forms. They also show variation in symmetry, exine structure and sculpture.

Identification of bee forage plants and their propagation helps in proving the bee forage which in turn improves the efficiency of beekeeping industry and commercial honey production. Karnataka is one of the leading states in India in beekeeping development. This study helps beekeepers to formulate this seasonal bee management schedule particularly for migrating of bee colonies to different floral sources. These studies will be useful for indentifying flora used by honeybees and improve the conservation status of economically important plants. The pollen morphology is also useful to identify various species and taxa in their respective families. It is useful to identify the pollen present in honey samples in order to know the botanical and geographical origin of honey.

Name of the plant	Botanical name	Flowering Blooming seasons	Habit	Bee forage value (nectar/pollen	Economic importance
Amla.	Phyllanthus emblica L.	March-May	Tree	N***P**	Fruit, tannin
Agathi.	Sesbania grandiflora p.	February- April	Small Tree	NP*	Medicinal
Ber Tree.	Ziziphus Sps.	March-June	Tree	NP**	Fruit
Castor.	Ricinus Communis L.	May- August	Shrub	P**	Seed oil
Cotton.	Gossypium arboreum L.	July-September	Shrub	N*P*	Fibre
Coral Tree.	Erythrina Spp.	March-June	Tree	N**P**	Shade Tree
Cholam.	Sorghum Spp.	Jan-December	Herb	N**P	Millet; fodder
Mexican weed.	Argemone Mexicana L.	May-July	Herb	P***	Medicinal
Neem.	Azadiracta indica	May-September	Tree	N**P**	Medicinal-Multi purpose
Lablabplant.	**Dolichos lablab.**	**Jan-December**	**Climber**	**N**P****	**Vegetable**
Gram.	Vigna Spp.	March-May	Climber	N**P**	Vegetable
Field beens.	Vicia Spp.	April-August	Climber	N**P**	Food, Fodder
Star goose berry.	Phyllanthus acidus L.	April-June	Tree	N**P**	Fruit, Tannin
Thuthi.	Abutilon Spp.	January-Decmber	Shrub	N**P**	Medicinal
Lady's finger-Bhendi.	Abelmoschus esculentus.	July-September	Herb	N**P**	Vegetable
Shoe flower.	Hibiscus rosasinensis.	January-Dec	Shrub	N**P**	Ornamental
Drumstick tree(Moringa tree)	Moringa oleifere L.	Jan-December	Tree	N*P**	Vegetable
Bottle Brush.	Callistemon citrinus(C.)	April-May	Tree	N*P*	Ornamental tree
Guava.	Psidium gujava.	May-June	Tree	N***P***	Fruits
Eucalyptus.	Eucalyptus Spp.	Feb-April	Tree	N*P*	Timber
Tamarind.	Tamarindus indica L.	Mar-May	Tree	N*P***	Condiment
Gulmohar.	Delonix regia.	May-June	Tree	N***P**	Ornamental

Based on the bee farmers and visual observations, more than 150 plant species were recorded out of which 58 species were found to be major sources for honey bees. January, February, march are the most favorable months Spring season (mid March-mid May) were identified as honey flow periods. This is based on the availability of different plants along with their flowering time.

Depending upon the climatic conditions, possibility of planting multipurpose plants has been discussed. Based on available flora, major charecteristics of these plant species, utility status and flowering season a bee floral calendar was developed. To conserve these floras, attention must be made to maintain and multiply the existing flora. However attention must be given to maintain the existing bee flora and multiplication of multipurpose plant species in order to make it sustainable. Some traditional bee farmers informed that the honey from Lyonia avalifolia, Prinsepia utilis and some species of Rhododendron aswell as cannabis sativa yielded toxic nectar, which are non-poisonous to honeybees but poisonous to human health. This was also reported earlier by Kafle (1992). The success of bee keeping depends not only on honeybee strains its management and hive structures, but also on the abundance and availability of bee floral plants around bee farming area (Sanjaya Bista and Gopal Shivakoti, 2001).

Honey Bees are a key component of global food security. Some of the bee visitation crops that 90% of the world's food, 71 are the bee pollinated and honeybees. (Apis mellifera L.) are the managed pollinator to provide the necessary pollination services for most of these crops (United Nations food and Agriculture organization 2005.) in the United States alone honey bee pollination is valued at US$20 Billion (Calderone) 2015 over the past decade, there has been a sharp increase in the number of honey bee colony losses in the United States, Often exceeding 30% per year. (Lee *et al*.2015.)

Bee plant relationship

Available honey bee plants and floral calendar in different months.

Nectar and pollen rich plants enhanced by pollinating bees at our Annamalai nagar crop eco system.

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